

Blended Learning Research Brief No. 1 | Associations Between Math Learning Software Use and Personalized, Competency-Based Instructional Strategies

Key Finding

Utah teachers whose students used math learning software at high levels in 2022-2023 were more likely to report utilizing three personalized, competency-based instructional strategies than teachers whose students did not use software or who used software at low levels.

Background

In January 2023, the Utah State Board of Education (USBE) released an updated version of [Utah's Personalized, Competency-Based Learning \(PCBL\) framework](#). In this document, the USBE highlights essential components of PCBL environments, noting, for example, that PCBL environments:

- allow students to “make important decisions about their learning experiences, how they will create and apply knowledge, and how they will demonstrate their learning” (p. 1),
- provide students opportunities to “learn actively using different pathways and varied pacing” (p. 1),
- shift the focus away from “seat time” and toward a learning environment in which “each learner is provided with or selects appropriate and timely support to achieve growth or competency” (p. 5), &
- encourage students to “take responsibility for their learning” by providing opportunities for students to “monitor their own progress and use data/observations to adjust their actions accordingly” (pp. 1 & 9).

Although there is evidence that personalized, competency-based learning environments can bolster student achievement (e.g., Pane, Steiner, Baird, & Hamilton, 2015), much remains to be learned about how to effectively implement PCBL strategies and about the role that educational technology might play in supporting these strategies (Pane, 2018). Advocates of “technology-enabled instruction” argue that emerging technologies – including adaptive learning software – have the potential to support the creation of strong PCBL environments by alleviating a key implementation challenge: intensive demands on teachers’ time. Specifically, advocates argue that, because these technologies can address *some* of the essential elements of PCBL environments (e.g., providing individualized content and pacing as well as data about students’ progress), teachers can more effectively work with individual students or with small groups of students in ways that are responsive to students’ unique skills, interests, and experiences (Brizard, 2023; Huebner & Burstein, 2023; Pane, 2018).



In Fall 2022, the Utah Education Policy Center (UEPC) partnered with the USBE and Utah’s STEM Action Center with the goal of contributing to the evidence base on best practices for creating “blended learning” environments that combine strong face-to-face instruction with emerging educational technologies. The UEPC will be releasing its findings in a series of research briefs. The current brief focuses on one key research question:

Were Utah teachers who used math learning software in their classrooms in 2022-2023 more, less, or equally likely to report using personalized, competency-based instructional strategies than teachers who did not use this software?

Methods

In Spring 2023, 2,416 K-12 mathematics teachers in Utah completed a survey administered by the Utah Education Policy Center (UEPC) to assess teachers’ use of personalized, competency-based instructional strategies and math learning software.¹ Survey respondents were asked to respond to 15 items assessing their instructional strategies (e.g., “I

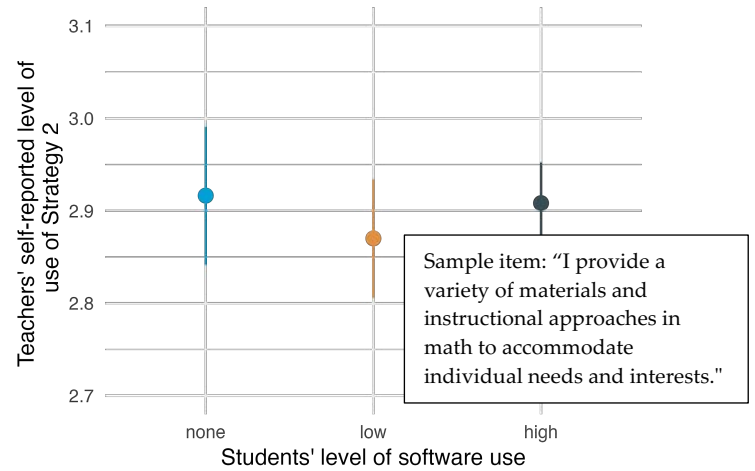
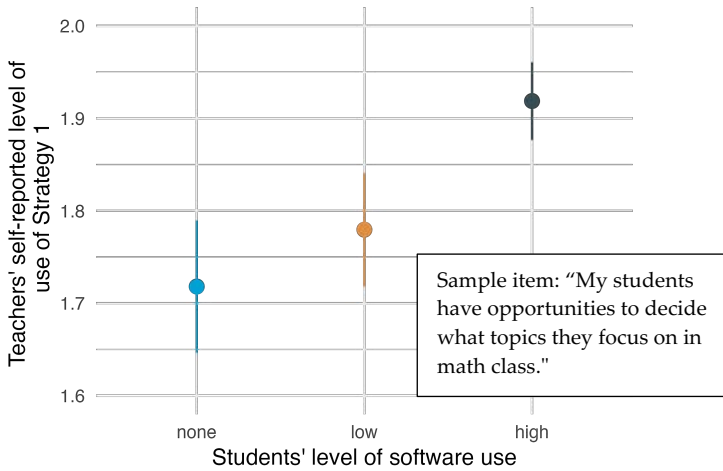
give students the chance to work through instructional material in math at a faster or slower pace than other students in this class.”) on a four-point scale that ranged from 1 (“not at all”) to 4 (“to a great extent”).ⁱⁱ Factor analysis of these items yielded four subscales – supporting agency, allowing differentiation, encouraging mastery, and promoting self-regulation – that are consistent with Utah’s PCBL framework. Teachers were also asked to report whether they used math learning software and, if so, the average number of minutes students in their classrooms used the software per week. **Low** math software use was operationalized as less than or equal to 30 minutes per week. **High** math software use was operationalized as greater than 30 minutes per week.

Strategy 1 – SUPPORTING AGENCY (mean = 1.87)

A set of strategies that empower students to make important decisions about their learning experiences.

Strategy 2 – ALLOWING DIFFERENTIATION (mean = 2.92)

A set of strategies that allow students to learn actively using different pathways and varied pacing.

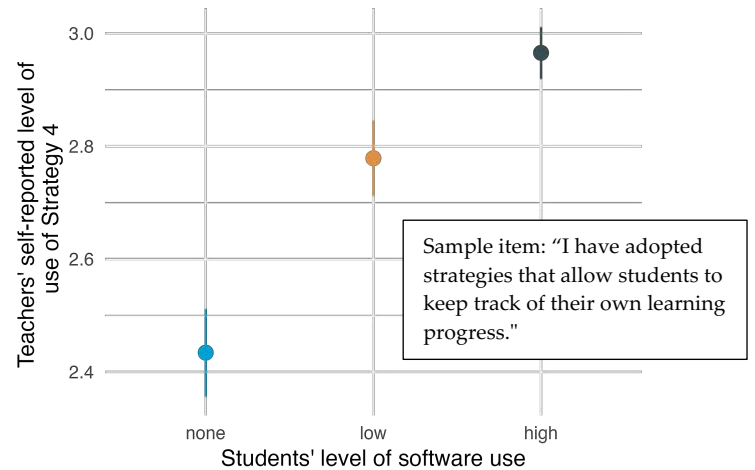
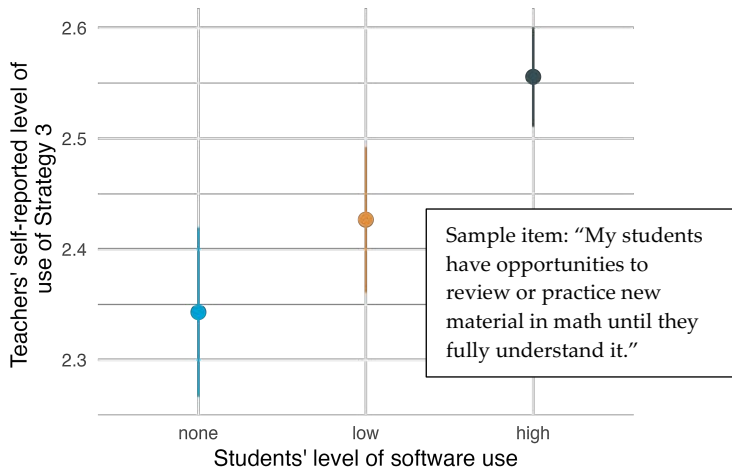


Strategy 3 – ENCOURAGING MASTERY (mean = 2.47)

A set of strategies that encourage students to achieve and demonstrate mastery of concepts.

Strategy 4 – PROMOTING SELF-REGULATION (mean = 2.75)

A set of strategies that empower students to monitor and guide their own progress.



Note. In the figures, brief descriptions of each strategy are provided along with means for the full sample of respondents. Points represent estimated marginal means from regression analyses at each of three levels of software use. Lines emanating from these points represent 95% confidence intervals.

Analyses

Regression analyses were used to predict teachers' self-reported use of each of four PCBL instructional strategies from their students' average weekly software use: none ($n = 325$), low ($n = 401$), or high ($n = 949$). Analyses controlled for the context in which teachers were using math software (elementary vs. secondary), the number of years teachers taught math, and school-level low-income status (i.e., the percent of students who qualified for free- or reduced-priced lunch) as initial analyses indicated that these variables predicted PCBL instructional strategies, weekly software use, or both.

Findings

Among the four PCBL instructional strategies assessed in the current study, teachers were most likely to report that they allowed differentiation (mean = 2.92), with teachers, on average, reporting that they allowed students to learn actively using different pathways and varied pacing "to a moderate extent." Allowing differentiation is the only strategy for which ratings did not vary by level of student math software use. Teachers were somewhat less likely to report supporting student agency (mean = 1.87), encouraging mastery over "seat time" (mean = 2.47), and promoting self-regulation (mean = 2.75). In all three cases, there were statistically significant differences in ratings by levels of software use such that teachers were more likely to report using these three personalized, competency-based instructional strategies when their students used math learning software at relatively high levels (that is, more than 30 minutes per week, on average) than when their students used math learning software at relatively lower levels (that is, 30 minutes per week or less, on average) or not at all, $ps < .001$.

Conclusions, Caveats, and Next Steps

The findings of the current study suggest that math learning software is *one* tool that teachers might utilize to create personalized, competency-based environments. Teachers who used math learning software at relatively high levels were more likely to report supporting student agency, encouraging mastery, and promoting self-regulation than teachers whose students did not use software or used software at relatively low levels. These findings do not, however, indicate that software use is the *only* tool or *best* tool for personalizing learning. Indeed, teachers reported relatively high levels of differentiation regardless of their level of use of math learning software. Moreover, the findings here reported are correlational. Although regression analyses controlled for some potentially important third variables (e.g., # of year of teaching), other third variables cannot be ruled out. In addition, the directionality of the relationship is unclear: software use may increase teachers' ability to personalize the learning environment, teachers who are dedicated to creating personalized learning environments might be drawn to software, or both.



Together, these findings are consistent with Utah's PCBL framework which indicates that Utah's schools and districts can move toward PCBL in a variety of ways including by offering early college experiences, engaging students in project-based or community-based learning opportunities, *and* creating online or blended learning experiences for students. These findings are also consistent with growing evidence that, "when applied skillfully and strategically," adaptive technologies can be an important tool in addressing learner variability and, in turn, tackling historic and pandemic-related achievement gaps (Brizard, 2023, p. 14). Efforts to transform teacher education programs, provide professional learning opportunities, and enhance partnerships among educational researchers, practitioners, and software developers will be important next steps in ensuring that existing and emerging educational technologies are, indeed, skillfully and strategically applied.

Beginning in Fall 2023, the UEPC will join teacher survey data with student survey data, student achievement data, and student usage data to explore the degree to which teachers' self-reported use of personalized, competency-based

instructional strategies – alone or in combination with math learning software use – are associated with gains in student achievement outcomes in mathematics. An important component of these analyses will be examining factors that moderate these associations including teacher implementation strategies (e.g., the degree to which teachers access data about student progress), teacher characteristics (e.g., # of years of teaching), and school characteristics (e.g., percent of low-income students).

References

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ⁱ A full report on survey results can be found on the [Utah Education Policy Center website](#). Importantly, the sample of teacher respondents was similar to the population of K-6 teachers and 7-12 grade math teachers in Utah who were invited to participate in the survey.

ⁱⁱ Items assessing personalized, competency-based instructional strategies were adapted from surveys developed by the RAND Corporation for a series of reports on personalized learning implementation and its effects.